REMARKS

Claims 1-5, 11-13, 16, 19-21, 23-26, 31-34 and 35-40 are pending. Claims 35-40 are new.

1. Claims 1-5, 11-13, 16, 19-21, 23-26 and 31-34 were rejected under 35 U.S.C. 112, first paragraph. Applicants respectfully traverse this rejection.

The PTO states that because the specification, while being enabling for aspect ratios up to 0.59, does not reasonably provide enablement for the entire range for producing a single crystal boule at a process aspect ratio of not less than 0.44. Accordingly, the PTO appears to be requiring an upper limit for the process aspect ratio.

In support of its positions, the PTO alleges that the Applicant admitted, in the Declaration dated February 15, 2007, that increasing boule size for a given melt/crucible has been found to deteriorate crystal quality. However, the PTO's statement is a misinterpretation of Applicant's Declaration. In fact, in the Declaration dated February 15, 2007, Dr. Kokta describes the general understanding in the crystal growth arts. That is, crystal growth scientists typically seek to minimize the mass of the growing crystal relative to the mass of the melt from which it is drawn. Based on conventional understanding, by minimizing the mass of the growing boule relative to the melt, a large melt fraction is maintained in the crucible which helps ensure homogeneous crystal growth and prevents undesirable shifts in stoichiometry of the melt. Thus, Dr. Kokta points out that, in the conventional processes, large size boules are generally achieved through scaling of the mass of the melt and the crucible and not by increasing boule size relative to the mass of the melt and the crucible. In other words, the simplistic approach of increasing boule size for given melt/crucible was found, in the traditional crystal growth arts, to deteriorate crystal quality. As such, Dr. Kokta refutes the PTO's previous assertion that one of ordinary skill in the art would have been motivated to increase boule size independent of crucible diameter.

In contrast to the present rejection, Dr. Kokta points out in the Declaration that higher process aspect ratios prevent undesirable crystallographic flipping. Dr. Kokta states that he and his co-inventors empirically discovered the crystallographic effects for the claimed spinel boule system, which were not predicted by any particular scientific theory or formulated methodology.

Instead, Dr. Kokta and his co-inventors found the benefits of high process aspect ratios to be quite surprising in the context of non-stoichiometric spinel crystal growth and contrary to conventional wisdom within the single crystal growth arts. As such, Dr. Kokta's statements are opposite the PTO's demonstrated understanding.

For at least the foregoing reasons, Applicants respectfully request reconsideration and withdrawal of the 35 U.S.C. 112, first paragraph rejection.

2. Claim 33 was objected to under 37 CFR 1.75(c). Claim 33 has been amended to depend from claim 11. As such, Applicants respectfully request reconsideration and withdrawal of the objection to the claims under 37 CFR 1.75(c).

3. Claims 1-5, 11-13, 16, 19-20, 23-26, and 31-32 were rejected under 35 U.S.C. 103(a) as being unpatentable over Grabmaier ("Czochralski growth of magnesium-aluminum spinel," hereinafter "Grabmaier") in view of Wachi et al. (JP 2001-080989, hereinafter "Wachi") and in view of Robinson et al. (U.S. 3,808,065, hereinafter "Robinson"). Applicants respectfully traverse this rejection.

In regard to the references, the PTO alleges that Grabmaier teaches a single crystal spinel having a composition suggestive of spinel crystal boule of the claimed formula. However, the PTO asserts that Grabmaier is silent to the aspect ratio. The PTO turns to Wachi, stating that Grabmaier is silent with respect to the aspect ratio.

The PTO asserts that Wachi teaches that the aspect ratio is a result effective variable in a Czochralski process and discloses aspect ratios equivalent to a range of 0.3125-0.4545. Previously, Applicants correctly asserted that Wachi is directed to and limited to a notably different crystal system gallium arsenide (GaAs) as stated by Dr. Kokta in the Declaration submitted February 15, 2007. In the context of non-stoichiometric spinel crystal growth, he and his co-inventors empirically discovered that the crystallographic effects were not predicted by any particular scientific theory or formulaic method, and Dr. Kokta contrasted such discovery with traditional crystal growth conventions. Applicants additionally submit that one or ordinary skill in the crystal growth arts would not apply process conditions disclosed in relation to GaAs chemistry to chemistries as different from GaAs as spinel chemistries. Contrary to GaAs

systems and other conventional single crystal growth systems, non-stoichiometric spinel crystals grow in a manner that is unexpected. Contrary to conventional wisdom within the single crystal growth arts, growth of non-stoichiometric spinel crystals at process aspect ratios greater than 0.44 and, in particular, aspect ratios greater than 0.50, provide an unexpected improvement in crystallography and yield. On the other hand, conventional wisdom would lead those of ordinary skill in the single crystal growth arts to work at process aspect ratios of less than 0.44. A supplemental Rule 132 Declaration will be submitted clarifying these points.

In response to Applicant's previous arguments, the PTO states that the Wachi reference is merely relied upon for its broad teaching regarding the Czochralski process, not the material growth, which is taught by Cullen or Grabmaier. However, the teachings of Wachi are only enabled in the context of the compositions and crystal systems disclosed within the reference, namely GaAs. The Czochralski process is highly empirically driven (i.e., not derived from theory), falls within the chemical arts, and as such, is an unpredictable area. The PTO has long recognized that one cannot apply process conditions relevant to one chemical system to the process of another unrelated chemical system. GaAs is clearly different to a system represented by the general formula $aAD{\cdot}bE_2D_3$, wherein A is selected from the group consisting of Mg, Ca, Zn, Mn, Ba, Sr, Cd, Fe, and combinations thereof, E is selected from the group consisting Al, In, Cr, Sc, Lu, Fe, and combinations thereof, and D is selected from the group consisting O, S, Se. Accordingly, the teachings of Wachi cannot be applied to crystal systems other than those recognized within the reference and, in particular, cannot be properly applied to non-stoichiometric spinel crystals.

In claim 32 and other claims newly presented, Applicants also recite aspect ratios of not less than 0.50 and not less than 0.52. In regard to such aspect ratios, the PTO suggests that the aspect ratios are a result effective variable based on the teachings of Wachi and that large diameter crystals are desirable. In addition to the teachings of Wachi being associated with GaAs and not non-stoichiometric spinel materials, Wachi teaches away from using higher aspect ratios. Specifically, Wachi discloses that, when using the specific range of ratios 2.2 to 3.2 (equivalent to process aspect ratios of 0.31 to 0.45), the repeatability of the diameter of the crystal growth is better, and a compound semiconductor crystal at high yield can be obtained. Wachi also points out that, when the ratio of a diameter of a crystal and a crucible are less than

2.2 (i.e., a process aspect ratio greater than 0.45), yield becomes low because a solid liquid interface is not stabilized. In addition, Wachi points out that yield also becomes low when using a ratio greater than 3.2 (i.e., a process aspect ratio of less than 0.31) because of a sharp fluctuation of the path of a growing crystal. Accordingly, Wachi teaches that, for GaAs, a specific range is desirable, not more and not less. Even if the teachings of Wachi could be properly applied to non-stoichiometric spinel crystals, Wachi clearly teaches away from aspect ratios greater than 0.45. A *prima facie* case of obviousness may be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. (see MPEP 2144.05). Wachi clearly teaches away from use of the claimed aspect ratios.

Accordingly, Wachi is deficient with respect to the claimed aspect ratios. Grabmaier and Robinson are silent with respect to aspect ratios and fail to enable one of ordinary skill in the art to deviate from conventional practices.

For at least the foregoing reasons, claims 1-5, 11-13, 16, 19-20, 23-26, and 31-32 are patentable over Grabmaier in view of Wachi in view of Robinson. As such, Applicants respectfully request reconsideration and withdrawal of the 35 U.S.C. 103(a) rejection.

4. Claim 21 was rejected under 35 U.S.C. 103(a) as being unpatentable over Grabmaier in view of Wachi in view of Robinson and further in view of Li (U.S. 5,968,267). Applicants respectfully traverse this rejection.

Grabmaier in view of Wachi and in view of Robinson is deficient with respect to aspect ratio. Li is relied upon by the PTO for allegedly teaching rotating the crucible to grow a crystal. Li is silent regarding aspect ratio and thus, fails to overcome the deficiencies of Grabmaier in view of Wachi and in view of Robinson.

For at least the foregoing reasons, claim 21 is patentable over Grabmaier in view of Wachi in view of Robinson and in further view of Li. As such, Applicants respectfully request reconsideration and withdrawal of the 35 U.S.C. 103(a) rejection.

5. Claims 1-5, 11-13, 16, 19-20, 23-26, and 31-32 were rejected under 35 U.S.C. 103(a) as being unpatentable over Cullen et al. (U.S. 3,883,313, hereinafter "Cullen") in view of Wachi and in view of Robinson. Applicants respectfully traverse this rejection.

The PTO asserts that Cullen allegedly teaches a single crystal spinel having the claimed composition. However, the PTO acknowledges that Cullen does not specifically teach an aspect ratio of greater than 0.44. Again, the PTO turns to Wachi.

For at least the foregoing reasons expressed above with respect to Wachi, Wachi fails to teach or suggest use of an aspect ratio of not less than 0.44 with respect to non-stoichiometric spinel crystal growth and specifically teaches away from using aspect ratios of greater than 0.45 for GaAs crystal systems. Robinson is also silent with respect to aspect ratio. As such, the combination of Cullen in view of Wachi in view of Robinson is deficient.

For at least the foregoing reasons, claims 1-5, 11-13, 16, 19-20, 23-26 and 31-32 are patentable over Cullen in view of Wachi in view of Robinson. As such, Applicants respectfully request reconsideration and withdrawal of the 35 U.S.C. 103(a) rejection.

6. Claim 21 was rejected under 35 U.S.C. 103(a) as being unpatentable over Cullen in view of Wachi in view of Robinson in further view of Li. Applicants respectfully traverse this rejection.

As stated above, Cullen in view of Wachi in view of Robinson is deficient with respect to aspect ratios of not less than 0.44 and is further deficient with respect to aspect ratios of not less than 0.50. Li fails to overcome these deficiencies.

For at least the foregoing reasons, claim 21 is patentable over Cullen in view of Wachi and in view of Robinson in further view of Li. As such, Applicants respectfully request reconsideration and withdrawal of the 35 U.S.C. 103(a) rejection.

7. Claims 35-40 are new and recite subject matters supported by the present specification and patentable over the cited references.

Applicant(s) respectfully submit that the present application is now in condition for allowance. Accordingly, the Examiner is requested to issue a Notice of Allowance for all pending claims.

Should the Examiner deem that any further action by the Applicants would be desirable for placing this application in even better condition for issue, the Examiner is requested to telephone Applicants' undersigned representative at the number listed below.

The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 50-3797.

Respectfully submitted,

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Date

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